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Geo-Informatics Application for Micro-Level Land Resources and Utility Mapping for Sustainable Rural Development of Sarvan Village in Goa, INDIA

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ABSTRACT

Micro-level resource mapping and planning using geo-spatial technology hold significant importance in various fields, ranging from agricultural and crop development, rural development and environmental management to disaster response and public health. Here are some key aspects highlighting the significance of micro-level resource mapping and planning with geo-spatial technology. This research focuses on employing geo-spatial technology at the micro-level to map resources for sustainable rural development. The case study investigates Sarvan village in Goa, utilizing primary data from GPS surveys and secondary data from Google Earth Mapping, QGIS, and SAGA software. The study emphasizes the role of technology in understanding and managing diverse resources for holistic and sustainable rural development. The focus is on environmental, economic, and socio-cultural sustainability, emphasizing utility services and land-use patterns. The findings reveal the impact of urbanization on rural identity, economic shifts, and environmental changes, prompting recommendations for sustainable land-use planning and Agro-tourism development.

Key Words: Sustainable development, GPS Survey, Google Earth, QGIS and SAGA Software

1. Introduction

Micro-level resource mapping using GPS survey and geospatial technology plays a crucial role in achieving sustainable rural development. This approach involves the use of Global Positioning System (GPS) technology and geospatial tools to collect, analyze, and visualize data at a granular level, allowing for better decision-making and resource management. The primary goal is to understand and optimize the use of natural and human resources in rural areas to enhance overall sustainability. The concept of micro-level resource mapping using geo-

spatial technology and its significance in the context of sustainable rural development. It outlines the challenges faced by rural areas, emphasizing the need for accurate data to inform decision-making. Sarvan village in Goa is introduced as the case study, highlighting its relevance in the context of the research.

Goa, is India's smallest state by its geographical area and the fourth smallest by population. The state has been a very important historical and cultural centre since ancient times. In a Hindu scripture Mahabharata, it is referred as Gopakpattan or Gomant and in Sutra- Samhita it was mentioned as Govapuri. Located on India's West coast, Goa is a former Portuguese colony with prolific history. The state has unique blend of Indian and Portuguese culture, art and architecture that pulls approx 2.5 millions (wiki) tourists every year. And hence Goa is visibly different from the rest of India. Goa is one such captivating tourist destination in India which has something to offer to every enthusiast traveler coming here, nevertheless of budget and varying travel habits. It is also a popular honeymoon destination. The real beauty of Goa lies in its beautiful beaches, places of worship and world heritage architecture. It also has bountiful flora and fauna, owing to its location on the Western Ghat Range and it is classified as a biodiversity hotspot. Hence, for the sustainable development of the state proper land resource mapping and planning is essential. Geo-spatial technology plays a crucial role in micro-level resources and utility service mapping for its proper planning.

2. Role of Geospatial Technology

This section delves into the instrumental role of geo-spatial technology in micro-level resource mapping. It discusses the applications of GPS surveys for utility services and QGIS/SAGA software for land use and land cover mapping. The integration of Google Earth Mapping is highlighted for its contribution to spatial analysis. The section emphasizes how these technologies enhance precision and facilitate a comprehensive understanding of resource distribution.

3. Aim and Objectives

The aim of present study is to Micro-level resource mapping. Which will be achieved by following objectives.

- **a.** To create the LU/LC database of Sarvan Village
- **b.** To find out the major utility services.
- **c.** To find out the potential of study area for sustainable development.

4. Study Area

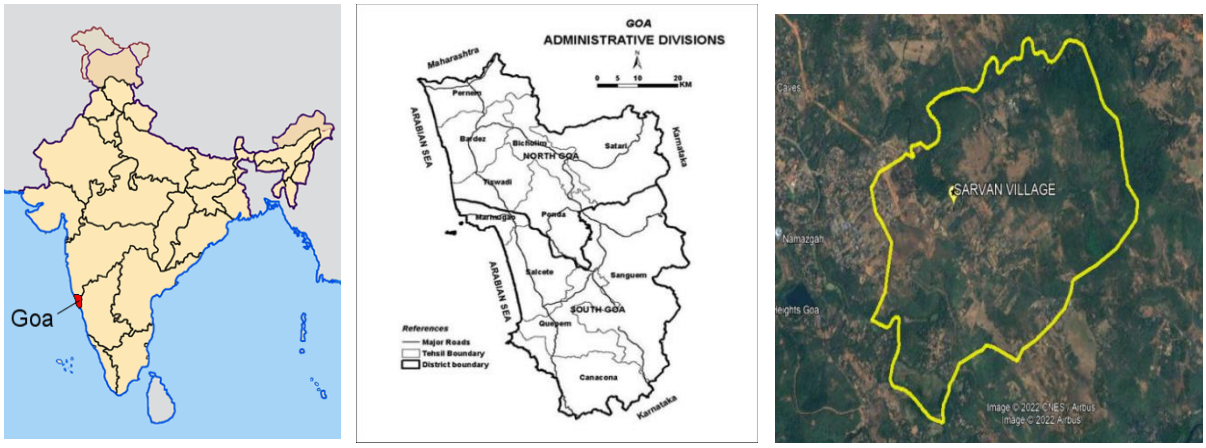

Fig1: Location Map of Sarvan Village, Goa

Sarvona village, located in Bicholim taluka of North Goa district in Goa, India, holds significance in the context of rural development and sustainable planning. The emphasis on rural development has grown over time, recognizing the importance of micro-level resource mapping and systematic planning in these areas. Key features about the Sarvan Village is:

- Geographically this village is situated 3km away from the sub-district headquarter, Bicholim (tehsildar office), and 33km away from the district headquarter, Panaji. The village is located in the Bicholim taluka of North Goa district. The total geographical area of village is 785.86 hectares.
- Sarvona has a total population of 3,586 people, with 1,865 males and 1,721 females. The village comprises about 787 houses.
- Sarvona village serves as a case study in the broader context of rural development, showcasing the importance of understanding and planning at the micro level. The application of geo-spatial data contributes to informed decision-making for sustainable development in the region.

5. Data and Methodology

In the present research both primary and secondary data has been used. Primary data collected from the extensive GPS survey to collect utility services and ground truthing of land use and land cover resources in the study area. In Secondary data, google earth mapping done to collect land use land cover information. The detail about the data and methodology used is given here.

Table 1: Data Used for the research

Primary Data	Secondary Data
Field Survey: GPS Survey	**1.Planning Map**
GPS Locations of Utility Services	**2. Google Earth**
Temples	Forest Land
Hospitals	Agriculture
Institutes	Settlement
Administrative Offices	Other
Other Utility Services	

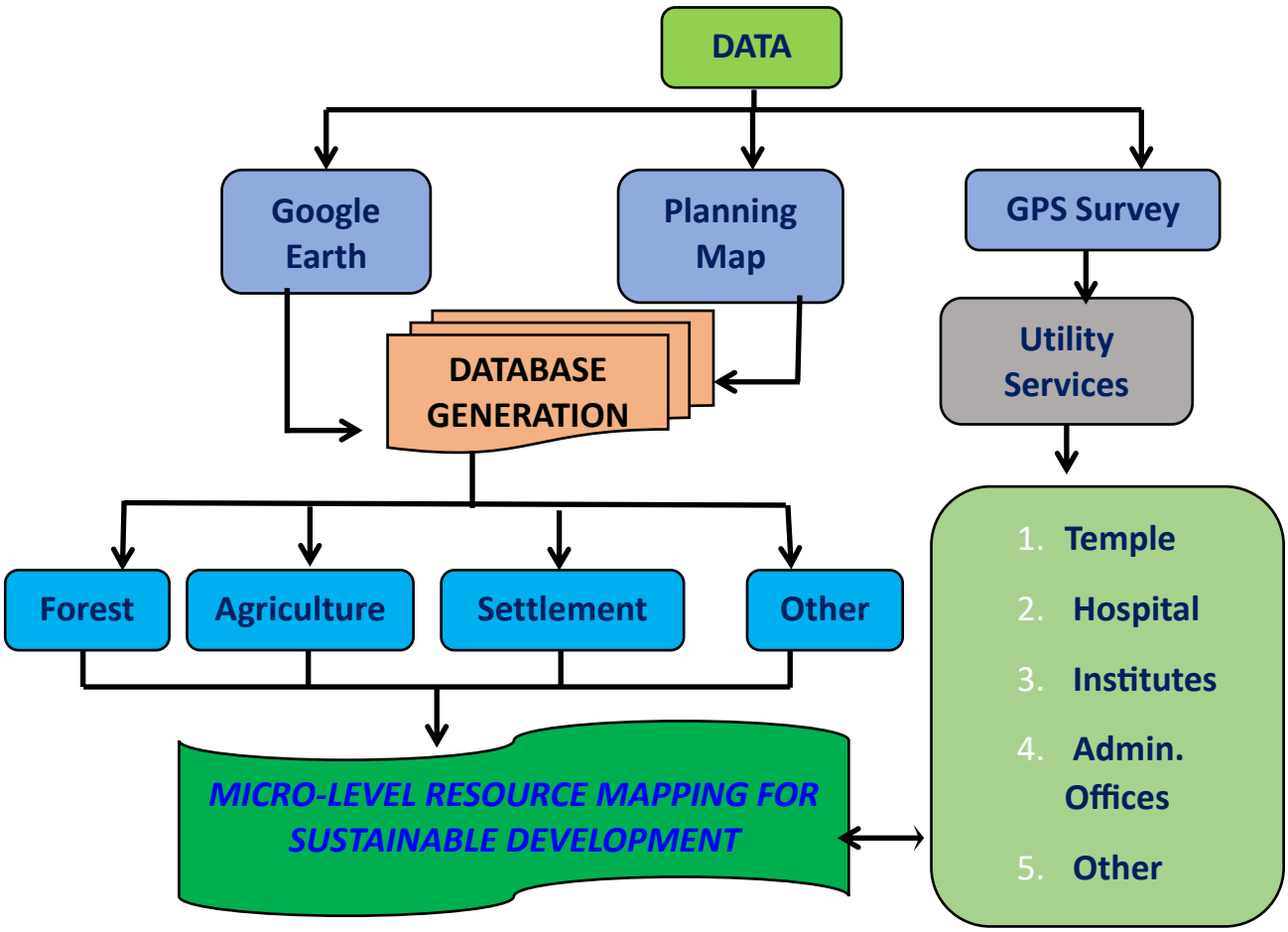

Fig 2: Location Map of Sarvan Village, Goa

6. Result and Discussion

The focus of the research paper has been on three aspects of sustainable tourism development: environmental sustainability, economic sustainability, and socio-cultural sustainability. The demarcation of the utility services was purely done with the help of QGIS and SAGA software. This paper has used the variables with the help of two sources such as primary and secondary data sources are as follows temples, hospital, institutes, administrative offices, other utility services; secondary variables include forest, agriculture and settlement.

a. Metalled and Unmetalled Roads of Sarvan

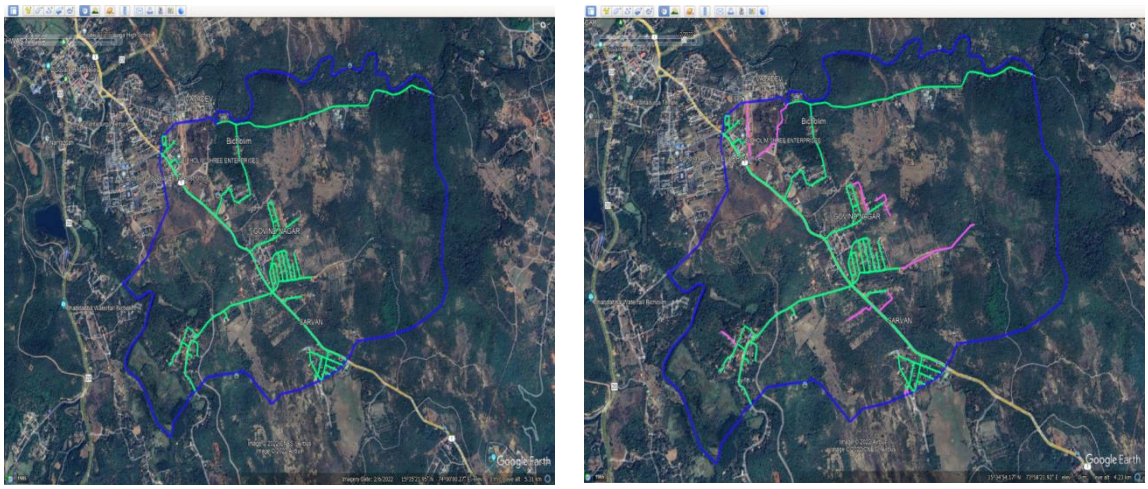

Fig 3: Road Network in Sarvan Village

Rural areas are under the constructive lines of sub urbs and it is the reason for the development of the rural areas. The above map suggests that near the SH 1, which runs exact in the middle of Sarvan village has given the horizontal growth in the exploration of many resources. As from the independence of Goa till 2023 the value of the land price increased from Rs. 120 per sq. meter to 10,000 plus in the newly cleared zones and patches of land in Sarvan. And thus, it has helped the local panchayat to invest lot of money in the proper construction of roads. The pink color is given to recent unmetalled roads which will gear up the new concrete hubs. Though the roads build by the local authority are smooth and luxurious but they are also reasons for many accidents. As per data more than 10 accidents occurs due to absence of speed breakers, cattle's, absence of street lights etc. Mamea Suringa is one of the flowers well known for Sarvan. Along the road side one can see very rare species of these plants unnecessary widening of the roads and pollution has been a reason for pollution in the major corners of the village.

b. Canal **c. Water Resources: Perennial River and Nalas**

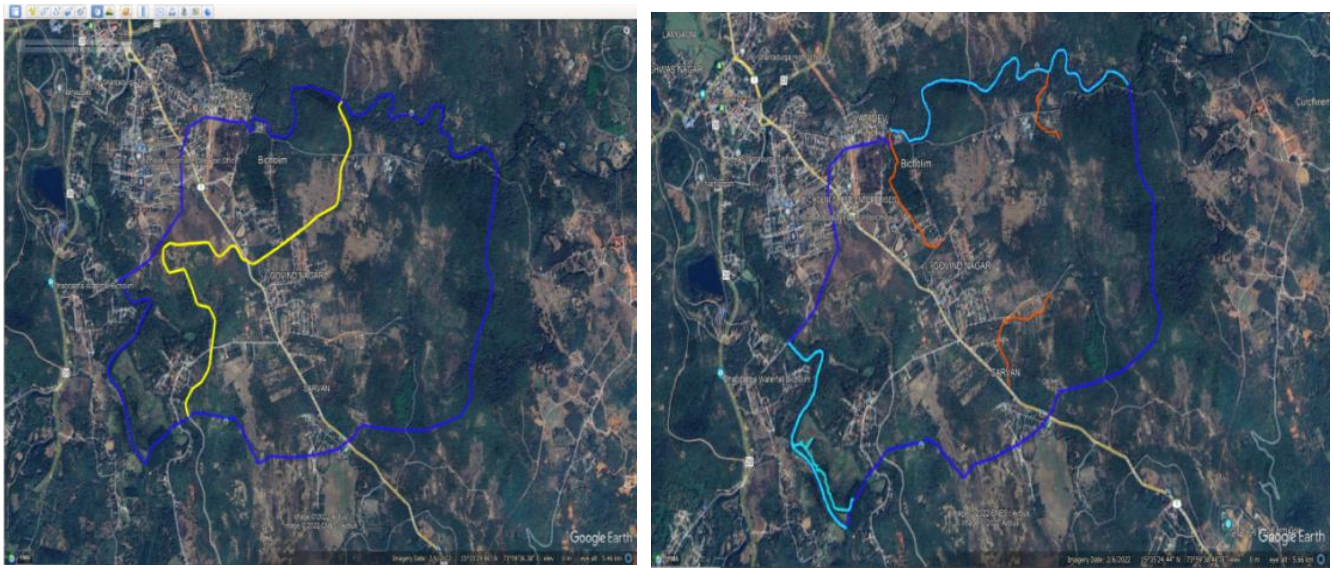

Fig 4: Road Network in Sarvan Village

Sarvan is blessed by the tributary of river Mhadai, 'Valvanti' river by the two supportive ends. The river is perennial and some nalas are seasonal in nature. It drains the low-lying core areas of river Sarvan and also, it's a major source of many smaller ponds and lakes. There is a lake near Dhatin, Kulan areas also majority of the people from Vathadev and Vautir uses the same water for there domestic purpose. On the other hand, in commercial line the same water is utilised for arecanut/beetalnut/supari plantation. Local ladies' washes clothes and during 'Mahashivaratri' Valvanti has deep roots sacred beliefs, holiness and faith in the thought processes of the people.

The Land cover indicates the physical land type such as forest or open water whereas land use documents how people are using the land. This village serves on the border lines for two talukas and it has gain lot of importance in terms of settlements as it has increased the land prices along the lateral road lines. Southern portion of this village is existing before the independence and north portion of the land is gloomed up in recent 10 years as major residential areas with some basic amenities or facilities. Places are Golkulwadi, Govindnagar, Ektanagar etc. where the commercialization is on trend.

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d. Utility Services **e. Land Use /Land Cover mapping**

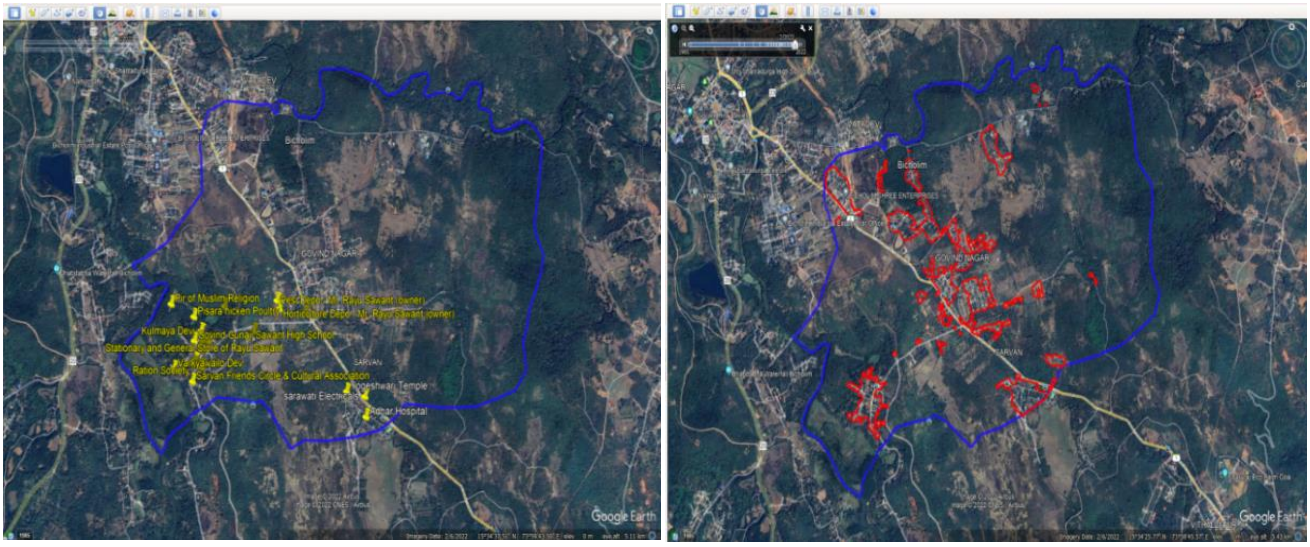

Fig 5: Utility and LU/LC Mapping on Google Earth

- **Land Use/Land Cover Mapping:**

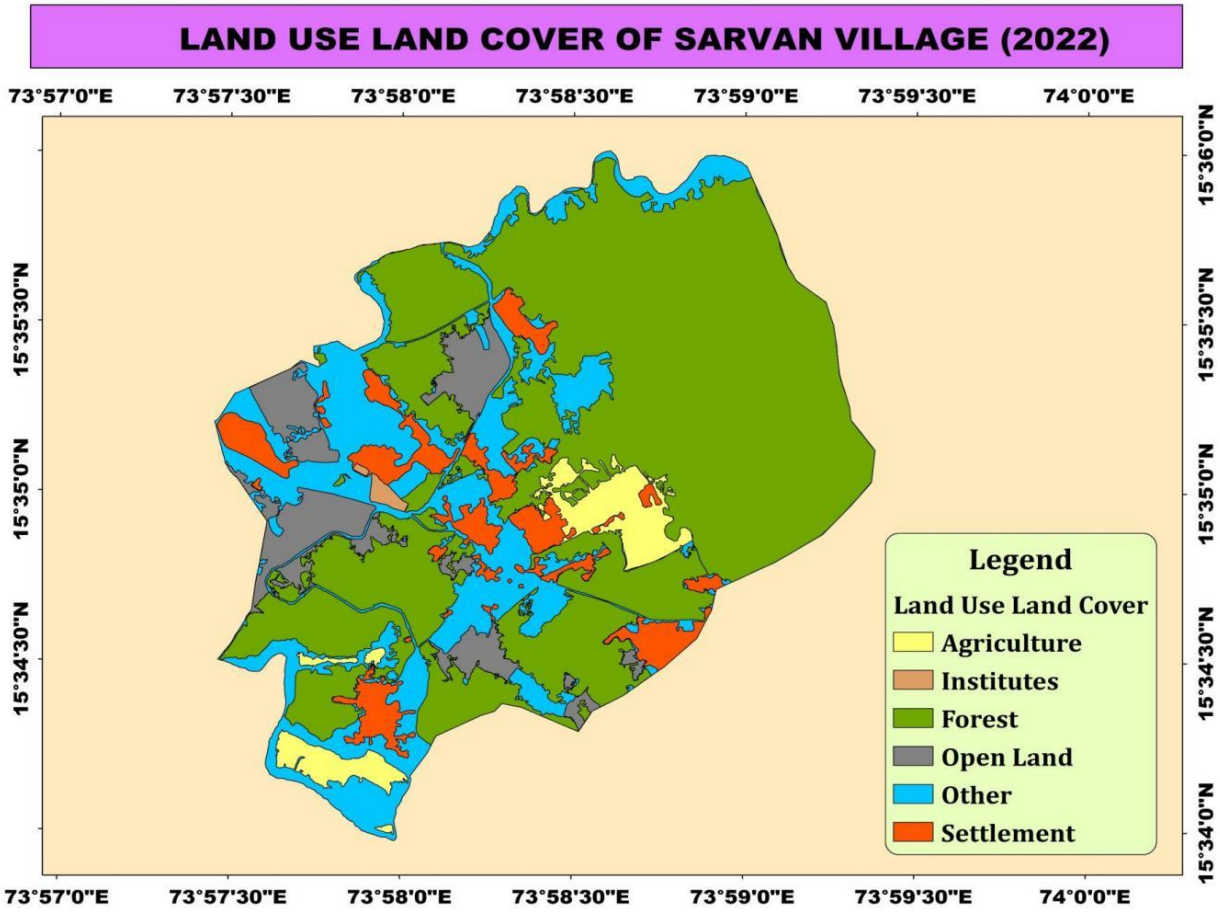

Fig 6: LU/LC Mapping in GIS Platform

The Land Use and Land Cover in the study area has changed due to factors like:

i. Need of land for a various purpose. (Construction of canal, governmental work specially road widening, PWD buildings, illegal encroachment on communidade lands by locals and internal migrants etc.)
ii. Shift due to Rural – Urban migration from main village Sarvan. Major internal settlement in Ektanagar and Govindnagar.
iii. Upcoming colonies sold to people from other states. And there is fear of change in socio-cultural activities in local area.
iv. The extinction of Mammea Suringa tress over a period of time

Table 2: Distribution of Land Use/Land Cover

Sr.No	Class	Area_Sq.m	Area (in %)
1	Institutions	22619.87	0.30
2	Settlement	578587.87	7.55
3	Agriculture	232244.31	3.03
4	Open Land	915020.11	11.94
5	Forest	4606216.26	60.13
6	Other	1306211.58	17.05
	TOTAL	**7660900**	**100**

Table 3: Distribution of Land Use/Land Cover

Institutions	0.30
Settlement	7.55
Agriculture	3.03
Open Land	11.94
Forest	60.13
Other	17.05

- **Utility Service Mapping:**

Land-use planning and, more broadly, land resource planning (LRP), are tools for achieving the sustainable and efficient use of resources, taking into account socio-economic and cultural dimensions. The availability of suitable

tools and information to support and satisfy the needs of decision-makers at different scales, across sectors and among stakeholders is limited, however

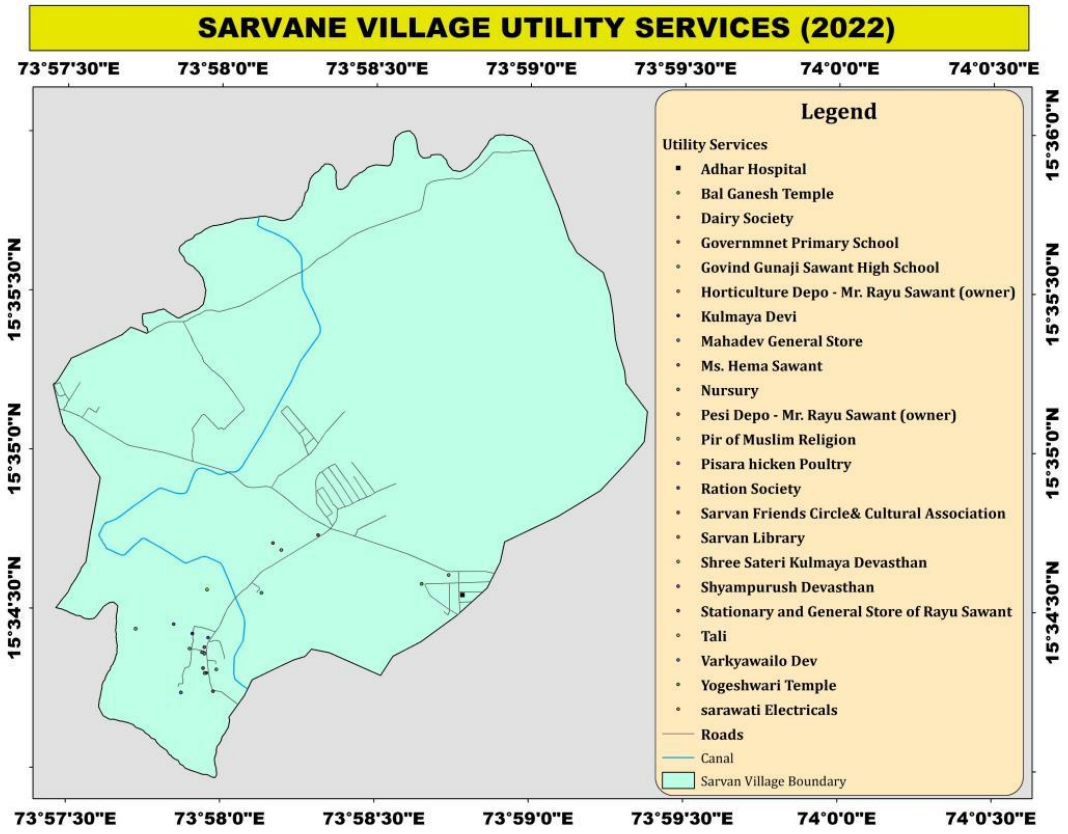

Fig 7: Utility services Mapping in GIS Platform

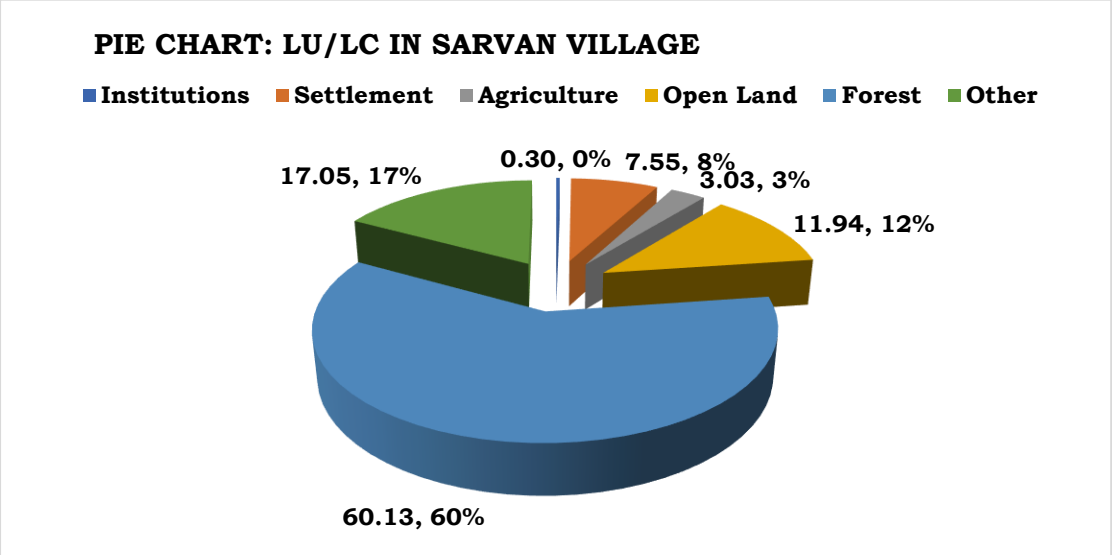

Fig 8: Pie Chart of LU/LC Distribution

Considered to be the land of temples and a centre for culture, locals of Karapur Sarvan village in Bicholim are afraid that the pace of urbanisation will erode the rural identity of the village. With farmers abandoning their fields and real estate booming, locals speak about protecting the area's natural resources. Locals feel that the same has given the village that urban touch, which has brought with it, certain trends that can change the shape of the village. One of the reasons, why the locals are apprehensive is due to the fact that the real estate value of the village area going up. While, plots are being developed and sold for commercial and residential projects, on the other hand, many of the locals are abandoning their fields, given that the price of the land has gone up. Ironically, the government had recently proposed to upgrade Karapur Sarvan into an urban village. While the gram sabha of the village panchayat had unanimously rejected this proposal, locals have demanded the government should instead, focus on improving basic infrastructure as well as developing the lake and springs at Sarvan.

7. Recommendations

- Use of agricultural area only for sustainable development such as plantation of cashew crops, coconut trees etc.
- Preservation & protection of medicinal trees such as mammea suringa.
- Government with local people should think in terms of sustainable tourism to promote local folklore and traditional activities.

8. Conclusion

Current and emerging needs in land resource planning for food security, sustainable livelihoods, integrated landscape management and restoration. The topic provides an overview of the historic development and status of implementation of land evaluation and land-use planning concepts and tools for land resource and landscape management, and it proposes recommendations for future actions. The increasing and juxtaposed challenges of population growth, demands on limited resources by diverse actors, land degradation, biodiversity loss and climate change require the rational use of resources to sustain and enhance productivity and maintain resilient ecosystems.

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